In response to revised drinking water regulations that decreased the allowable level of arsenic in drinking water in 2006, EPA funded a study to assist the Tribe in evaluating existing conditions for public water systems in the First and Second Mesa areas that were known to exceed the maximum contaminant level (MCL) for arsenic and recommend viable engineering solutions to ensure regulatory compliance. Beginning in 2008, the Hopi Water Resources Department began working with IHS and EPA to complete an arsenic mitigation study. As a baseline, the following data was collected at local well sites to quantify the water quality issues relating to arsenic and begin the process of seeking sustainable solutions.

		First Mesa		Second Mesa				
		Keams Canyon, Wells 2 & 3 Composite	Polacca Well #8	Lower Sipaulovi - Mishongnovi Well	Upper Sipaulovi Well	Second Mesa Day School Well	New Shungnopavi Well (Drilled 2008)	Shungopovi Well
Parameter	Units	Result	Result	Result	Result	Result	Result	Result
Alkalinity	mg/L	340	320	280	270	290	240	240
Iron, Total	mg/L	<.05	0.11	0.26	<.05	<.05	0.22	<0.050
Arsenic, Total	ppb	38	20	18	18	19	33	15
Arsenic, Trivalent	mg/L	0.026	0.016	<0.0020	0.0022	<0.002	Unknown	0.005
Calcium	mg/L	<5	<5	<5	<5	<5	<5	<5
Magnesium	mg/L	<5	<5	<5	<5	<5	<5	<5
pH	pH Units	9.4	9.6	9.7	9.7	9.7	9.94	9.8
Solids, Total Dissolved	mg/L	460	380	350	330	340	350	300
Sulfate	mg/L	26	17	18	16	15	22	21
Turbidity	NTU's	<1	<1	3.3	<1	<1	2.4	<1.0
Silica	mg/L	13	15	18	18	17	24	19
Vanadium	mg/L	<.05	<.05	1.5	1.5	1.7	Unknown	0.33
Average Well Production Rate	gpm	150*	100	90	9	50	(Offline) Unknown	65

* Value represents combined yields of Well #2 & #3 assuming pumping rate of 75 gpm per well

As indicated in the table above, all wells serving the First and Second Mesa region exceed the MCL for arsenic which is set at 10 parts per billion (ppb). Generally, the arsenic concentrations in Second Mesa range from 15-20 ppb and increase as one moves eastward towards First Mesa where Keams Canyon wells register the highest arsenic concentration in the region at 38 ppb. The exception to this trend occurs at the newly drilled Shungnopavi well which was sampled after drilling and was shown to have an arsenic concentration of 33 ppb. Also noted was the unusually high pH of the tested waters coupled with high alkalinity and the absence of hardness (calcium and magnesium). This odd combination of water quality attributes makes the water of this region very difficult and potentially expensive to treat for arsenic removal. All of the treatment techniques evaluated (adsorption, coagulation filtration (CF), reverse osmosis, ion exchange) to remove arsenic from the regions' groundwater will require pH adjustment which will prove difficult and costly given the high buffering capacity indicated by the high alkalinity. Also noted, was the likelihood that water in the First Mesa area would require preconditioning through a process known as oxidation to convert the naturally occurring arsenic into a form that has a higher affinity for removal. These, among other complicating factors led the arsenic mitigation team to advise against

water treatment options if a non-treatment solution could be identified. Based on the stated observations, high anticipated operating cost of treatment facilities, the operational difficulties experienced by existing local treatment systems and lack of financial resources, the team looked elsewhere to identify a higher quality water source that could be developed to serve the region.

After reviewing Hopi area wells, research identified a region 15 miles north of the Hopi Cultural Center referred to as "Turquoise Trail/ Tawa,ovi" which, according to a report completed by Thompson Pollari and the WLB Group in 2005, has an existing well with superior water yield potential and an arsenic concentration of 3-4 ppb. The report contains pump test data and water quality information for the Navajo Aquifer in the Turquoise Trail region that suggests favorable conditions that may support development of this area as a primary water source for the villages that are currently out of compliance with regulations related to arsenic. Alternate locations were evaluated for well field development near the Hopi Veteran's Center (HVC) near Kykotsmovi. Although the existing wells in the HVC area demonstrate compliant arsenic concentrations of 7 ppb, they do not yield anywhere near the quantity of water that is apparently obtainable in the Turquoise Trail region.

Below is a table generated using data presented by TetraTech EM Inc in a Hopi Source Water Assessment conducted in 2005-2006. The table offers a summary of water usage statistics organized by each of the public water systems that are out of compliance with the arsenic rules.

Public Water System	PWSID #	*Average Daily Water Usage (GPD)	Equivalent Continuous Pumping Rate Based on 12 hr Day (GPM)
Polacca FMCV, Including Hospital & Polacca Day School	090400106	77900	108.2
Hopi High School	090400395	57600	80.0
Shungnopavi	090400259	34000	47.2
Hopi Cultural Center	090400260	6000	8.3
Lower Sipaulovi/Mishongnovi	090400107	14100	19.6
Upper Sipaulovi Mishingnovi	090400394	7600	10.6
Second Mesa Day School	0400057	11000	15.3
Total, Minimum Required Yield		**208200**	**289.2**
* Source Hopi Source Water Assessments, TetraTech EM Inc., January 2006			

As indicated above, the minimum required yield needed to serve the identified users is 208,200 gallons per day or a continuous equivalent pumping rate of 289.2 gallons per minute based on a 12 hr day. It is anticipated, based on the previously discussed existing well data, that the Turquoise Trail region is capable of supporting wells that can produce as much as 500 GPM+. As reported in the Thompson Pollari --WLB Group report, the existing well

(Tawa'ovi/Turquoise) was pump tested at 345 GPM for 21 hours with a corresponding drawdown of 125 ft. The static water level was 521 ft bgs prior to pumping and the terminal dynamic water level was measured at 646 ft bgs at the end of the test. The pump was set at 1,700 ft bgs so at the end of the pump test there was still a water column of 1,054 ft over the pump. This is emphasized to demonstrate that the final pumping rate of 345 gpm was likely a limitation of the test pump and not necessarily reflective of the true yield potential of the well/aquifer.

After assessing the water needs of the area and reviewing the Turquoise Trail well data, the Hopi Water Resources Department, IHS and EPA collaboratively developed the Hopi Arsenic Mitigation Project Concept. This concept proposes to develop a new well field in the vicinity of the existing Turquoise Trail well to take advantage of the higher quality water which appears to be available in sufficient quantity to serve the First and Second Mesa villages. The water would be delivered to each of the communities by a large piped network that would be constructed over the course of several construction phases. The concept-level cost estimate to design and construct the proposed water system is between 20 to 25 million dollars. It is anticipated that the cost estimate will vary as the concept is further developed through the collection of design data during the planning process which is ongoing. During the past two years, the EPA and IHS have committed grant funding to further explore and develop the arsenic mitigation concept.

Over the course of the past two years, several informational meetings pertaining to the arsenic mitigation concept have been held with various stakeholders including community members, community leaders, utility operators, federal water system regulators and federal funding agencies. At each of the individual gatherings there has been overwhelming support for the project as the meeting participants acknowledge that this is a project devised to improve the health of the served communities. On the other hand it has been difficult to assemble multi-community meetings which will be critical as the arsenic mitigation team solicits comments from the affected communities to determine how best to operate and maintain a shared water system. This project is substantially larger in scope and cost than ordinary sanitation projects in the area and will require funding from multiple sources as no single agency can administer a grant in the amount required to fund the project in its entirety. In early discussions with federal agencies that would likely be candidates to assist with funding this project, the arsenic mitigation team has been informed that this project will not be grant eligible until a defined plan is formed detailing how the system would be operated and maintained and by what utility management entity.

As the arsenic mitigation team endeavors to advance this project beyond the conceptual phase, planning activities will continue for the next couple of years. Those activities will include efforts to further validate the Turquoise Trail region as a viable community water source, conduct environmental investigations, perform mapping activities, participate in community forums and seek multi-party input to collaboratively define the path that will lead to an abundant, safe drinking water source.